



Use of Mobile Phones in the Operating Room

A Literature Review

Gomeyac, Shielou Ann

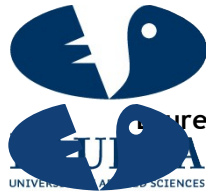
2017 Laurea



Laurea University of Applied Sciences

Use of Mobile Phones in the Operating Room: A literature review

Gomeyac, Shielou Ann C.
Degree Programme in Nursing
Bachelor's Thesis
November, 2017



UNIVERSITY OF APPLIED SCIENCES
LAUREA
AMMATTIKORKEAKOULU

Shielou Ann Gomeyac
Shielou edella

Laurea University of Applied Sciences
Degree Programme in Nursing
Bachelor's/Master's Thesis

Abstract

Use of Mobile Phones in the Operating Room: A Literature Review

Year	2017	Pages	29
------	------	-------	----

The main purpose of this study was to identify the benefits and consequences of the use of mobile phones in the operating room. The study's aim was to collect information about the topic for the benefit of the health care community.

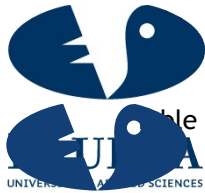
The literature review is based on 5 scientific research articles. Data was obtained from different research articles from internet databases such as PubMed, CINAHL, ProQuest, and EBSCO host. Literature was analyzed and organized using an inductive thematic analysis to ensure the reliability of the study.

Findings of this literature review reveal three benefits and 4 consequences of mobile phone use in the OR. The three benefits identified were under the subthemes Phone Application for Information, Camera Phones for Medical Imaging, and Ease of Communication. The four consequences were identified as Distraction, Issues in Hygiene, Medical Equipment Interference, and Ethical and Legal Concerns.

Technology is made with the intention of making our lives easier and more comfortable. But these technologies can bring more threats or risks if used inappropriately. Since mobile phones are personal, it is the responsibility of the owner/user to use it properly. The findings of this literature review are meaningful and provide information regarding issues and possible problems that arise from the use of mobile phones in the operating room. Although studies have been done revealing almost the same results, with the recent technological advances, some of these have changed.

The researcher would suggest future studies to be conducted using Finnish articles as it could help in the development of certain policies regarding mobile phone use in the different hospitals in Finland. Studies regarding current policies and guidelines with regards to cell phone use are also recommended.

Keywords: mobile phone, operating room/theatre, cellphone, smartphone, surgery



UNIVERSITY OF APPLIED SCIENCES

Together we are stronger

LAUREA

AMMATTIKORKEAKOULU

Uuden edellä

Table of Contents

1 Introduction

Mobile phones have become part of everyone's lives. With the recent developments in information technology, mobile phones are being used, not only for communication purposes, but also for multimedia purposes such as photography and music.

Mobile phones and Personal Digital Assistants (PDAs) have become an integral part of the physician's and any other healthcare professional's life. Aside from using these technology for personal purposes, they also had been used for work related purposes such as professional scheduling, obtaining patient's medical and drug information and work-related e-mails. Phone cameras have also been used to take pictures intraoperatively in the absence of cameras in the operating room. In addition to this, most surgeons use cellular phones to play music during a surgical procedure. A study found 66% of surgeons using their phones in the hospitals, including in operating theatres and intensive care units. (Saraf 2009.)

In the study made by Koehler et al. (2013), 91% of their health care professional respondents own a mobile phone, and 87% use it during their clinical practice. In addition to this, a survey conducted by McBride et al. (2015), reveals 78.1% (645/825) of registered nurses reporting using their personal mobile phone or other communication device while working.

The use of mobile phones, for both personal and professional use by health care providers had been common even in surgical departments, where the standards of cleanliness and sterility are believed to be at it's highest. Due to the increasing use of mobile phones in the hospital, studies had been conducted to determine its effects, both positive and negative, to the quality of care given to the patients (Patterson 2012).

The main purpose of this study is to identify the benefits and consequences of the use mobile phones in the operating room. The study aims to collect information about the topic for the benefit of the health care community.

2 Mobile Phones in the Operating Room

2.1 Mobile Phones and Features

Mobile phones are defined as is a telephone that you can carry with you and use to make or receive calls wherever you are (Collins dictionary 2017). It is commonly known as a cellular phone, cellphone or smartphone.

A smart phone is a mobile phone that performs many of the functions of a computer, typically having a touch screen interface, Internet access, and an operating system capable of running downloaded apps (Oxford dictionaries 2017).

Present day mobile/smart phones have different features that help users in their daily lives. Aside from the convenience of placing phone calls, mobile devices allow for immediate communication through text or email. Wireless connectivity provides instant Internet access, linking users to a myriad of magazines, e-books, television shows, social networking outlets, blogs, games and thousands of mobile apps. These present day technology/gadgets had been providing health care professionals access to information easily and cost-effectively.

Wallace et al (2012) define “apps” to be software programs that have been developed to run on a computer or mobile device to accomplish a specific purpose. A smartphone application is defined as a software application that is installed on a smartphone or other portable devices. Smartphone applications are compact software programmes that perform specific tasks for the mobile users. There are two types of smartphone applications. The native application is that which must be installed on the device or are preinstalled in the device. The web applications are those that can be downloaded and accessed with the use of the internet. These software applications is had been widely used by health care professionals making information retrieval and communication easier. (Attri et al. 2016.)

Medical applications can be used to access information about drugs and drug interactions, read textbooks and journal articles, perform medical calculations, determine prognosis and undertake professional development. They offer opportunities for surgeons to support preoperative, intraoperative and postoperative care. (Warnock 2012.)

Mobile phone cameras enables one to instantly take pictures and videos. In addition to this, the software applications that are available in smartphones aid in sharing these pictures and videos conveniently (Greenier 2012).

2.2 Operating Room

Operating room also called surgery center, is the unit of a hospital where surgical procedures are performed. An operating room can be designed to provide care to different types of patients requiring different levels of care. In the operating room, specialized equipments are commonly used to help in caring for patients whose conditions are either specific or indefinite. (Surgery encyclopedia 2017.)

The operating room (OR) is a sterile area; all OR personnel follow protocols to keep it sterile. One example is the use of protective clothing, shoe covers, masks, caps, eye shields, and other coverings to prevent the spread of germs. The operating room environment is also modified to help prevent infection. It is brightly lit and the temperature is very cool/air conditioned.

Every operating room has equipments that help the surgical team during a surgical procedure. Such equipments include life support and emergency resuscitative equipments, patient monitoring equipments, diagnostic equipments and other special equipments depending on the types of procedures that are usually done in that specific operating theater. Examples of these are laser, laparoscope and surgical robots.

Electromagnetic radiation (EMR) is a type of radiation emitted by mobile phones that are believed to interfere with medical equipments. This has been a concern, together with the safe distance from the equipments and the capability of the equipments to prevent interference. Although many anecdotal reports exist of medical interference with medical electrical equipments, it is difficult to compare various studies due to the number of devices tested, non-uniform study designs and heterogeneous technological information. (Saraf 2009).

2.3 Intraoperative Nursing and Nurses' Roles

Intraoperative phase is the time when the patient is received in the operating room to the time the patient is admitted in the recovery room (Hope 2013).

During the intraoperative period, the patient is monitored, anesthetized, prepped, and draped, and the procedure is performed. Patient outcomes after the surgery depend on the surgical team. Team members are categorized into the sterile team and the nonsterile team.

Sterile team members are those who scrub their hands and arms, don sterile attire, contact sterile instruments and supplies, and work within the sterile field (i.e., the area immediately surrounding the surgical site). They are referred to as the "scrubbed" members of the team. Members of the sterile surgical team include the primary surgeon, assistants to the surgeon (i.e., other surgeons, residents, physician assistants, and Registered Nurse First Assistants), and the scrub person who may be a registered nurse, a licensed practical nurse, or a surgical technologist. Members of the nonsterile surgical team, on the other hand, carry out their responsibilities outside the sterile field and do not wear sterile attire. Members of the nonsterile surgical team include the anesthesiologist, the nurse anesthetist, the anesthesia assistant, the circulating nurse, and others. (Jbpub 2012.)

To ensure a safe and effective care, each member of the surgical team has their own roles and responsibilities, but together, they work as a team. Kelvered et al. (2011) states that “the profession of theatre nurse has changed dramatically over the years. It has become highly complex and includes special skills, knowledge of medicine and advanced surgical techniques”. Nursing activities in the intraoperative period focus on assuring the safety of the patient, facilitation of the procedure, infection control and prevention, and satisfactory physiologic response to anesthesia and surgical intervention (Jbpub 2012).

The core function of theatre nursing is to continue developing patient safety by exercising control over the working situation through good planning, ‘being one step ahead’ and being responsible for aseptic conditions. They also want good partnership in the surgical team and to continue developing through practical experience. The theatre nurses emphasize that one of their most important nursing care procedures is to guarantee a hygienic, aseptic environment throughout the operation with the goal of minimizing the risk of a postoperative wound infection. The participants describe the way they constantly keep a watchful eye to ensure that no one in the team around the operating table contaminates sterile material by mistake. Constant monitoring of people who are not familiar with procedures, such as new students or visitors, is vital to maintain sterility. (Kelvered et al. 2011.)

3 Aim and Purpose

The main purpose of this study is to identify the benefits and consequences of the use of mobile phones in the operating room. The study aims to collect information about the topic for the benefit of the health care community.

Moreover, the study aims to answer the following questions:

- a. What are the benefits of mobile phones in the operating room?
- b. What are the consequences of the use of mobile phones in the operating room?

4 Methodology

4.1 Descriptive Literature Review

The research method used in this study is descriptive literature review. Descriptive literature review can be defined as “a review with a clear stated purpose, a question, a defined search approach, stating inclusion and exclusion criteria, producing a qualitative appraisal of articles” (Jesson et al. 2011, 12).

The development of a literature review involves four stages. The first stage is the problem formulation. This stage involves identifying a field or topic that will be

examined. Identifying what exactly is of interest and why can help refine the topic so that the final amount of information generated is manageable (Cronin et al. 2008).

The next stage is the literature search. Conducting a literature review involves using research databases to identify materials that cover or are related in some sense to the research topic. The selection of databases will be directed by the chosen subject or the topic of choice and the scope of the project. Key to performing an effective literature review is selecting search terms that will effectively identify materials that are relevant to the research topic. An initial strategy for selecting search terminology might be to list all possible relevant terms and their synonyms in order to have a working vocabulary for use in the research databases. (UNF Library 2017.)

The next step is analyzing and synthesizing the literature. During this phase, the chosen literature that was identified and determined as "appropriate literature" will have been gathered. Initially, the researcher must read through the articles to have a grasp on what the literature is all about. Most published articles has a summary or abstract that could help the researcher determine whether the paper in question will be used in the review. After the initial overview, it is important to re-read the articles and follow a systematic and critical review of the content. During this stage, the researcher is advised to have a short summary of each article and this summary may include themes, thoughts, key words, comments, strengths and weaknesses of the publication. (Cronin et al. 2008.)

The final stage is writing the literature review. During this stage, a discussion of the findings and conclusions is done basing on the analysis and interpretation of the reviewed articles (Cronin et al. 2008).

4.2 Database Search

Data was obtained from different articles/researches from internet databases such as PubMed, CINAHL, ProQuest, and EBSCO host. The electronic literature search on the different internet databases started on October 5, 2017. The search words that were used were mobile phone, operating room, cellphone, smartphone, operating theater, surgery and surgical procedure.

To help in reducing the number of articles found in the databases, the articles were chosen basing on the following inclusion and exclusion criteria. The inclusion criteria were:

1. The article is not older than 10years or published from 2007-2017.
2. The research respondents have a medical background, for example medical doctors, anesthesiologists, nurses, etc.
3. The article is published in English.

4. The article is peer reviewed and can be qualitative, quantitative or literature review.

and the exclusion criteria include:

1. Articles about the use of mobile phones in other parts of the hospital other than the operating room.
2. Articles published before 2007.
3. Undergraduate research/thesis.
4. Articles about the use of devices other than cellphones, for example tablet computers, i-pads and laptops.

During the the article selection, the search words and/or phrases were used to find articles from the databases. There were a total of 254 hits, but 214 of them were unrelated to the research subject and 4 of them were duplicate articles. The 36 articles were selected basing on their titles and abstracts. From these articles, 13 articles were chosen for full text/content review. Eight articles were excluded since their full content were either unpublished online, unavailable for download or can only be accessed through paid databases. In the end of the selection process, a total of 5 articles were left for the literature review. Figure 1 shows the selection process.

FIGURE 1. Article search and selection.

4.3 Data Analysis

A thematic approach was used in organizing the data. Thematic analysis (TA) is a widely-used qualitative data analysis method. It is one of a cluster of methods that focus on identifying patterned meaning across a dataset. The purpose of TA is to identify common patterns in the data acquired from the research and from these, to answer the research questions. Patterns are identified through the process of data familiarization and coding together with identification, development and revision of themes. (Braun et al. 2006.)

The thematic approach to analyzing data involves 6 phases (Braun et al. 2006). These phases are shown in Table 1.

Phase	Description
Familiarizing with the data	Reading and re-reading the data, noting down initial ideas.
Generating initial codes	Coding interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code.
Searching for Themes	Collating codes into potential themes, gathering all data relevant to each potential theme.
Reviewing themes	Checking the candidate themes against the

	dataset, to determine that they tell a convincing story of the data, and one that answers the research question. In this phase, themes are typically refined, which sometimes involves them being split, combined, or discarded
Defining and Naming themes	Developing a detailed analysis of each theme, working out the scope and focus of each theme, determining the 'story' of each. It also involves deciding on an informative name for each theme.
Producing the report	Weaving together the analytic narrative and data extracts, and contextualizing the analysis in relation to existing literature. discarded.

Table 1. Phases of Thematic Analysis

After the articles were reduced to 5, phase 1 and 2 were simultaneously done. The articles were read and re-read to be able to be familiar with the depth and breadth of the content. And their findings were summarized using a table (see Table 2). The table shows the title of the article, their corresponding authors, the country where the article was published, aim and purpose of the study, research method, respondents and results.

Codes were then identified and using inductive thematic analysis, wherein the themes identified are strongly linked to the data themselves. In this approach, if the data have been collected specifically for the research (e.g., via interview or focus group) the themes identified may bear little relationship to the specific question that were asked of the participants. The themes should also be protected from the researcher's bias regarding the topic. Inductive analysis is therefore a process of coding the data without trying to fit it into a pre-existing coding frame, or the researcher's analytic preconceptions. (Braun et al. 2006.) There were 7 initial themes were identified. The results of phase 3 and 4 are the initial thematic map as shown in Figure 2.

Phase 5 was done when the results were furthermore analyzed, and were then categorized into the benefits and risks of the use of mobile phones in the operating room (see Figure 3).

The results revealed common patterns, from which, themes were identified for both benefits and consequences. The sub themes for the benefits of mobile phone use in the operating room are "Phone Applications for Information", "Camera phones for Medical

Imaging” and “Ease of Communication”. On the other hand, sub themes for the consequences were identified as “Distraction”, “Issues in Hygiene”, “Medical Equipment Interference” and “Ethical and Legal Concerns”.

3. Final Thematic Map with 2 main themes and 7 subtheme

5 Findings

5.1 Benefits of the Use of Mobile Phones in the Operating Room

The researcher identifies three subthemes under the benefits of the use of mobile phones in the operating room. These subthemes are Phone applications for information, camera phones for medical imaging and ease of communication.

5.1.1 Phone Applications for Information

According to Warnock (2012), technological advances paved way or the improvement of software and hardware that are found in smart phones, hand-held tablets and “hybrids of both”, making daily tasks easier to accomplish.

Medical applications are widely available on both Android and non-android phones, such as Apple and Blackberry in facilitating communication, to place notifications and to provide relatives real-time information and updates regarding the surgery as they watch the procedure being performed in the comfort of the waiting areas (Attri et al. 2016).

Aungst (2013) states that the nature of these medical applications have paved way for mobile devices to be integrated in the health care practice. These apps offer quick access to “clinical references and point-of-care tools”, leading to better clinical decision-making and improved patient outcomes. Examples of such are diagnostic applications, drug reference applications that provide dosing guidelines and access to data on pharmaceuticals, medical calculator apps which provide medical formulas calculations, medical education applications which keep a log of surgical cases and procedures, and patient information apps that provide ease to reference materials, lab tests and medical records (Attri et al. 2016).

The use of personal mobile phones in the operating complex was observed to be common in halls, equipment storage rooms, instrument preparation rooms, break rooms and inside the operating room itself during a procedure. However, intraoperative use of mobile phones was limited to the non-sterile team members, such as circulating room nurses, anesthesiologists and nurse anesthetists. The circulating nurses add that they use of these gadgets during the periods where they are on “stand-by mode and their efforts were not directly required by the operating team”. Nurses justify their use of mobile phones to the use of medical applications to help them accomplish tasks such as checking unknown medications, making notes or annotations, checking unknown abbreviations and to learn more about specific procedures or instruments. (Sergeeva et al. 2016.)

Other non-sterile members of the surgical team such as the anesthesiologist and anesthesia nurses were also observed to use these devices intraoperatively. According to Attri et al. (2016), anesthesiologists browse the internet for journals and e-books. On the other hand, survey results by Smith et al. (2011) show that 18,9% of perfusionists report using the app specifically designed for perfusion applications (protocols, formulas, etc.).

5.1.2 Camera Phones for Medical Imaging

Mobile phone cameras had been widely used to capture clinically relevant images. For example, doctors have demonstrated new ways to interact with and record medical image data in specialties such as dermatology and neurosurgery. A published article states that neurosurgeons proved the of surgical use of the camera phone when they used a camera phone to take photographs of images from computerized tomography (CT) and magnetic resonance imaging (MRI). With the help of recent technology, they transferred high-resolution images to consulting physicians and since these images were of such high quality, the surgeons were able to diagnose intracranial hemorrhages and cerebral aneurysms down to 2 mm. (Razdan et al. 2006.)

The use of mobile devices for medical imaging is growing. With improved quality and rapidly declining cost, mobile health imaging has the potential to change the future of medical image capture. In addition to the information on the use of camera phones intraoperatively, Attri et al. (2016) states that smartphone applications are used for “visualization and navigation by orthopedicians”. The camera phones were attached to the arthroscope during an orthopedic procedure, and provided the operating team live videos for accurate alignment of joint replacement implants. Some apps also allow surgeons to perform simulated surgeries or anesthesiologists to make vital signs monitoring available anywhere at a low cost. These are useful for anesthesia providers who have to watch many cases at 1-time even when they are in different locations covering many ORs at one time. Furthermore, they facilitate learning, treatment and communication by capturing interesting diagnostic images or recording procedures.

Mobile phone apps also assist surgeons to improve availability of imaging. Apps that are downloaded in hand held tablets allow surgeons to access preoperative images anytime during the surgery, thus facilitating the surgical procedure in care of operating room workstation timeouts. Such apps may also facilitate the sharing of imaging results among hospitals and institutions with different jurisdictions. (Warnock, 2012.)

Lastly, nurses started to utilize the camera function to record specific arrangements of instruments on the table, configuration of equipments, and to learn and remember new or specific procedures. The camera also started to be used to take pictures of broken equipment to communicate problems to technicians or the sterilization unit, and when surgeons asked OR assistants to take a picture of something medically interesting discovered during the surgery. In addition to this, with the combined capability to easily transmit pictures made on the spot, the email function significantly enhanced the communication capabilities of nurses and the quality and quantity of information received. (Sergeeva et al. 2016.)

5.1.3 Ease of Communication

Communication in the hospital setting is essential for adequate patient care. Having a communication device that is efficient, works in a “two-way” manner and provides protection for confidential messages would be much appreciated in this environment. Mobile devices satisfy this need by offering multiple means of communication including: voice and video calling; text, e-mail, and multimedia messaging; and video conferencing. Clinical communication apps are available for mobile devices that are specifically designed to simplify communication among clinicians, patients and other health care providers. (Ventola 2014.)

Smith et al. (2011) states that “cell phone use as a primary communication tool provides the benefit of having multiple modes of communication. The technology of these devices has improved to the extent that voice, texting and e-mails are at the user’s fingertips”.

Other than providing ease of communication regarding patient cases through voice calls and text messaging, the mobile feature of having an email function allowed instant and easy sharing of visual or written information with other staff members. Email was used by nurses to read newsletters from management, to coordinate shifts with other nurses and to exchange minutes of meetings (Sergeeva 2016).

5.2 Consequences of the Use of Mobile phones in the Operating Room

5.2.1 Distraction

Noise pollutions exists as well in the operating suite environment. It is completely inevitable to irradiate noise inside the operating room since the source of noise pollution include monitoring equipments such as patient monitors and surgical equipment (Cammarata et al. 2014). In this article review, all five articles identified that the most common problem with mobile phone use intraoperatively is distraction. Distraction is most commonly caused by the sound of ringtones, alarms and inappropriate use of mobile phones.

Researches show that while mobile phone use inside the operating room is mostly work related, these devices were also used for non-work related and sometimes recreational purposes, such as personal email, Facebook, messaging friends and family, music, games, taking and sharing personal pictures. These non-work related mobile phone activities are considered inappropriate and were identified to pose a negative effect on the collaboration in the OR (Sergeeva et al. 2016).

The work of OR teams is collaborative, and it is important to study how this collaboration is potentially affected by the use of mobile devices. Attri et al. (2016) states that “when information is obtained under multitasking conditions, the flexible application of knowledge associated with creativity and adaptive problem solving may be less likely to occur”. Thus, if a person’s focus or attention is divided between tasks, response time and the decision making ability is affected.

Two of the reviewed articles mentioned the term “inattention blindness”. This refers to the situation in which “cell phone use causes withdrawal of attention from the external scene around the subject and directs the attention to the internal cell phone conversation” (Smith et al. 2011). Cognitive performance is negatively affected by smartphones. According to Attri et al. (2016), their use increases reaction time, reduces focus and lowers performance of tasks needing mental concentration and decision making. In the different health care settings, especially in the special areas of the hospital, even a small mistake can prove fatal.

In the survey conducted by Sergeeva, et al. (2016), distraction was the most often mentioned disadvantage of mobile phone use. Basing on the survey, the researchers identified three concerns over distractions caused by mobile devices. These are 1) Distraction from core clinical tasks, 2) Distraction from collaboration, and 3) Distraction from hands-on learning.

5.2.2 Issues in Hygiene

Nosocomial infections are a serious problem in all modern hospitals. Hospital operating rooms are the workplaces with the highest hygiene standards. Due to the nature of the care provided in the operating room, the same high hygiene requirements also hold for the personnel working there and the equipments being used. (Jeske et al. 2007.) Mobile phones are used in closed contact with the body and unlike medical electronic equipments, there are no cleaning guidelines available to meet the standards and the hygiene risk involved in using mobile phones in the OR. In addition to this, cell phone manufacturers even warn explicitly against using cleaning agents, making it difficult for institutions to formulate guidelines regarding the cleaning of mobile phones. (Attri et al. 2016.)

In a research study by Jeske et al. (2007), the results show that the use of mobile or fixed phones by anesthetists working in the OR not only demonstrated a high contamination rate with non-human pathogen bacteria but also, more importantly, also caused a 10% rate of contamination with human pathogen bacteria.

In addition to this, a study was conducted in Ireland to test the bacteria carrying potentials of cell phones showed that of 70% of cell phones tested for bacteria that could cause infection, 96% were contaminated and 15% had bacteria known to cause health care associated infections (Attri et al. 2016).

5.2.3 Medical Equipment Interference

Electromagnetic radiation and its interference of the vital apparatus in the operating theater and ICU caused by smartphones had been a cause of concern over the past years. According to Attri et al. (2016), "smartphones must be kept at a safe distance from medical equipment and the medical equipment should have the ability to resist EMR".

However, with technological advancement, newer equipment is becoming less sensitive to interference as manufacturers are adopting to the increasingly stringent standards for screening (Saraf 2009; Attri et al. 2016). Recent literature also states that there is no clinically relevant electromagnetic interference as long as they are more than a meter away from sensitive equipments (Saraf 2009).

According to the survey conducted by Smith et al. (2011), 98.4% of respondents reported that they never have seen a cell phone cause interference with medical equipment while being used. Nevertheless, the respondents consider the following cell phone technology activities (speaking on a cell phone, texting, surfing the internet, checking e-mail, sending e-mail and posting on a social networking site) as unsafe when operating a heart-lung machine, leading to the strict adherence to the one-meter rule.

5.2.4 Ethical and Legal Concerns

As the use of mobile phones increase in the operating room, inappropriate use of these phones threat to patient safety and surgical team collaboration. Snoots et al. (2016) define inappropriate personal electronic device use as “any activity that is not patient centered and consists of, but is not limited to, accessing social media sites, personal text messaging, browsing the Internet, and/or unlawfully photographing or disseminating data”.

Snoots et al. (2016) discuss the legal implications of personal electronic devices and anesthesia. They mentioned that according to Thomas, B., a senior claims attorney and the director of risk management for medical professional liability insurance company, the use of PED's in the OR is causing legal and ethical concerns, leading to the recent rise in lawsuits. Furthermore, in comparison to “allegations of distractions” in the recent years, PEDs serve as “incriminating evidentiary support to plaintiff accusations by retrieving activity content that is dated and time-stamped”.

Mobile phones with a camera facility can also constitute a considerable risk. Their risk can be identified as possible breach of medical and patient confidentiality, invasion of patient's private life, and possible contravention of data protection act. Human error also plays a part in the possible breach of patient privacy and confidentiality. Although researches provide proof of improved communication with proper text messaging, “38% of people admit to sending a wrong-person text, raising cautionary flags to the risk of unintentional breach of patient privacy” (Snoots et al. 2016).

6 Discussion

6.1 Discussion of the Findings

The aim of this literature review is to identify the benefits and consequences of the use of mobile phones in the operating room. Findings of this literature review reveal three benefits and 4 consequences of mobile phone use in the OR.

Mobile phones definitely prove their intended use and importance when it comes to improving communication. Mobile phone features, like the camera and applications not only make them helpful tools in information retrieval and dissemination, but also make them effective accessories to the surgical instruments used in the OR.

But these benefits become consequences when used inappropriately. Concerns regarding distraction and patient's rights to privacy and confidentiality are two of the four consequences identified in this literature review. On the other hand, problems like issues in asepsis and equipment interference are among the unforeseen consequences.

The results of this review sheds light to possible uses of mobile phones that can improve patient care results. With emerging technology, these benefits might someday outweigh the risks of using mobile phones in the operating room, however, it is important that every institution must have or formulate guidelines on the use of hand held devices in the operating room, not only to maximize the benefits, but also to minimize the risks/consequences.

Implementation of these guidelines is also as important as the formulation itself. Because, it is a fact that, while there are operating room organizations around the world who have their own policies with regards to the use of mobile phones, these policies, however, are difficult to implement since some staff and physicians find ways to override them. Thus, strict implementation of these guidelines is also important.

6.2 Limitations

This literature review is limited to the articles found from the different online sources.

Published articles, as well as Finnish articles that could that can be found in the libraries were not included. Due to cost constraints, relevant articles available in paid databases were not included in the review.

6.3 Ethical Considerations and Reliability

The reliability of this study is established as this study used peer reviewed articles and published researches from reliable sources or databases basing on the inclusive criteria as mentioned above. In addition to this, the process of doing this review, as well as the analysis of the data was described clearly, thus, adding to the reliability of the study.

This study was conducted according to the responsible conduct of research. It followed the principles of integrity, meticulousness, and accuracy in conducting research and in recording, presenting and evaluating research results. Moreover, the study used a research method that conforms to scientific criteria and is ethically sustainable. The researcher complied with the standards set for scientific knowledge in planning and conducting the research, in reporting the results, and in recording the data obtained during the study. (TENK 2012.) Finally, proper referencing techniques to acknowledge the work and achievements of other researchers were used all throughout the study.

7 Implications for Clinical Practice and Recommendations for further Studies

The findings of this literature review are meaningful and provide information regarding issues and possible problems that arise from the use of mobile phones in the operating room. Although studies have been done revealing almost the same results, with the recent technological advances, some of these have changed. Examples include the issue with medical equipment interference and the use of phone cameras for medical imaging purposes.

The researcher would suggest future studies to be conducted using Finnish articles as it could help in the development of certain policies regarding mobile phone use in the different hospitals in Finland.

8 Conclusion

Mobile phones had become an important part of the healthcare community. With the recent technological advances, their role in improving communication and information retrieval makes them integral even inside the operating theaters. While they bring benefits, risks/consequences of the inappropriate use of these devices make them instruments for a medical or surgical catastrophe.

Technology is made with the intention of making our lives easier and more comfortable. But these technologies can bring more threats or risks if used inappropriately. Since mobile phones are personal, it is the responsibility of the owner/user to use it properly.

In the end, mobile phones can be both beneficial and detrimental at the same time, but it depends on the user. With appropriate use together with proper guidelines, these devices could be a great help in improving and providing safe patient care.

References

Online sources:

1. Cammarata, B. & Thomas, B. 2014. Technology's Escalating Impact on Perioperative Care: Clinical, Compliance, and Medicolegal Considerations. Accessed 17.10.2017. http://www.apsf.org/newsletters/html/2014/June/03_techimpact.htm
2. Collins dictionary. Mobile phone. Accessed 13.08.2017 <https://www.collinsdictionary.com/dictionary/english/mobile-phone>
3. Costello, Angela. 2017. Operating Room. Accessed 14.10.2017 <http://www.surgeryencyclopedia.com/La-Pa/Operating-Room.html>
4. Hope, I. 2013. Perioperative Nursing- Three phases. 2013. Accessed 13.08.2017. <http://rnspeak.com/perioperative-nursing/perioperative-nursing-three-phases/>
5. Jbpub. 2012. Introduction to Perioperative Nursing. Accessed 15.10.2017 http://samples.jbpub.com/9781449688066/87625_CH01_Pass2.pdf
6. UNF Library. 2017. Accessed 27.10.2017. <https://libguides.unf.edu/c.php?g=177129&p=1163761>
7. Literature Review: Conducting & Writing: Home, 2017. viewed 13 August 2017 <http://libguides.uwf.edu/c.php?g=215199&p=1420475>
8. Oxford Dictionaries. 2017. Smartphone. Accessed 14.10.2017 <https://en.oxforddictionaries.com/definition/smartphone>

9. Surgery encyclopedia. Operating room. Accessed 13.08.2017
<http://www.surgeryencyclopedia.com/La-Pa/Operating-Room.html#ixzz4pehgEAmI>
10. TENK. 2012. The responsible conduct of research. Accessed 04 October 2017
http://www.tenk.fi/sites/tenk.fi/files/HTK_ohje_2012.pdf

11. Warnock, Garth. 2012. The use of apps in surgery. Accessed 14.10.2017 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3310760/>

PRINTED SOURCES:

1. Attri J P, Khetarpal R, Chatrath V, Kaur J. Concerns about usage of smartphones in operating room and critical care scenario. Saudi J Anaesth [serial online] 2016 [cited 2017 Oct 29];10:87-94.
<http://www.saudija.org/text.asp?2016/10/1/87/169483>
2. Aungust, Timothy. 2013. Medical Applications for Pharmacists using Mobile devices. Annals of Pharmacotherapy. Vol 47, Issue 7-8, pp. 1088 - 1095. Accessed 16.10.2017
http://journals.sagepub.com/doi/abs/10.1345/aph.1S035?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dpubmed#articleCitationDownloadContainer
3. Braun, V. and Clarke, V. (2006) Using thematic analysis in psychology. Qualitative Research in Psychology, 3 (2). pp. 77-101.
http://eprints.uwe.ac.uk/11735/2/thematic_analysis_revised
<https://www.psych.auckland.ac.nz/en/about/our-research/research-groups/thematic-analysis/about-thematic-analysis.html>
4. Cronin, P., Ryan, F. & Coughlan, M. 2008. Undertaking a Literature Review: A step-by-step approach. British Journal of Nursing, 2008, Vol 17, No 1. Accessed 27.10.2017.
<https://lancashirecare.files.wordpress.com/2008/03/2008-undertaking-a-literature-review-a-step-by-step-approach.pdf>
5. Greenier, Ewa. 2012. Personal Mobile Device Use in the Operating Room. AANA NewsBulletin. May 2012. 24-25.
6. Jeske, H.-C., Tiefenthaler, W., Hohlrieder, M., Hinterberger, G. & Benzer, A. 2007. Bacterial contamination of anesthetists' hands by personal mobile phone and fixed phone use in the operating theatre. Journal of the Association of Anaesthetists of Great Britain and Ireland, 2007, Vol 62, p 904-906. Accessed 01.10.2017.
<http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2044.2007.05172.x/epdf>
7. Jesson, J., Matheson, L. & Lacey, F.M. 2011. "Doing Your Literature Review: Traditional and Systematic Techniques" SAGE Publications.
8. Kelvered, M., Öhlen, J. & Gustafsson, B. 2011. Operating theatre nurses' experience of patient-related, intraoperative nursing care. Scandinavian Journal of Carinf Sciences, 26(3): 449-457. Accessed 15.10.2017
<http://web.b.ebscohost.com.nelli.laurea.fi/ehost/pdfviewer/pdfviewer?vid=9&sid=64ab6642-392e-4419-bbfb-f547d436db5a%40sessionmgr103>

9. Koehler, N., Vujovic, O. & McMenamin, C. 2013. Healthcare professionals' use of mobile phones and the internet in clinical practice. Accessed 26.10.2017.
<http://www.journalmtm.com/2013/healthcare-professionals-use-of-mobile-phones-and-the-internet-in-clinical-practice-2/>
10. McBride DL, LeVasseur SA, Li D. 2015. Non-Work-Related Use of Personal Mobile Phones by Hospital Registered Nurses, *JMIR Mhealth Uhealth* 2015;3(1):e3
<http://mhealth.jmir.org/2015/1/e3/#Abstract>
11. Razdan S, Johannes J, Kuo RL, and Bagley DH (2006) The camera phone: a novel aid in urologic practice. *Urology* 67: 665-669. Accessed 16.10.2017.
[http://www.goldjournal.net/article/S0090-4295\(05\)01460-3/fulltext#Conclusions](http://www.goldjournal.net/article/S0090-4295(05)01460-3/fulltext#Conclusions)
12. Saraf S. 2009. Use of mobile phone in operating room. *J Med Phys [serial online]* 2009 [cited 2017 Aug 13];34:101-2. Accessed 04.10.2017
<http://www.jmp.org.in/text.asp?2009/34/2/101/51938>
13. Sergeeva, A., Kjeld, A., van den Hoof, B. & Huysman, M. 2016. Mobile devices in the operating room: Intended and unintended consequences for nurses' work. *Health Informatics Journal* 2016, Vol 22(4) 1101-1110.
https://www.researchgate.net/publication/285627284_Mobile_devices_in_the_operating_room_Intended_and_unintended_consequences_for_nurses_work
14. Smith, T., Darling, E. & Searles, B. 2011. 2010 Survey on cell phone use while performing cardiopulmonary bypass. *Perfusion* 26(5) 375-380. Accessed 27.09.2017.
<http://journals.sagepub.com/doi/abs/10.1177/0267659111409969>
15. Snoots, L. & Wands, B. 2016. Use of personal electronic devices by nurse anaesthetists and the effects on patient safety. *AANA J.* 2016; 84: 114-119
16. Patterson, P. 2012. Smartphones, tablets in the OR: With benefits come distractions. *OR Manager.* 2012; 28(4): 5-10.
17. Wallace, S., Clark, M., & White, J. (2012). "It's on my iPhone": attitudes to the use of mobile computing devices in medical education, a mixed-methods study. *BMJ Open*, 2(4), e001099.
<http://doi.org/10.1136/bmjopen-2012-001099>
18. Ventola, C. L. (2014). Mobile Devices and Apps for Health Care Professionals: Uses and Benefits. *Pharmacy and Therapeutics*, 39(5), 356-364.
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4029126/>

Tables:

TITLE AND JOURNAL SOURCE	AUTHORS AND COUNTRY OF PUBLICATION	AIM AND PURPOSE	RESEARCH METHOD AND RESPONDENTS	RESULTS
Mobile devices in the operating room: Intended and Unintended consequences for nurses' work <i>Health Informatics Journal</i> 2016 Vol. 22 (4), 1101-1110	Sergeeva, A., Kjeld A., van den Hooff B., and Huysman, M. The Netherlands	Identify both intended and unintended effects of the introduction and use of mobile devices on healthcare work practices, using the case of the use of mobile devices by operating room nurses.	Qualitative Action Research Operating room assistants/nurses (anesthetic and surgical assistants/nurses)	Mobile devices allow easy information access, e-learning and work-related communication (enhanced by imaging and improving cross-functional coordination with technicians and surgeons. Three areas of concern in relation to possible distracting effects of mobile devices: Distraction from core clinical tasks, distraction from collaboration and distraction from hands-on learning.
Concerns about the usage of smartphones in operating room and critical care scenario <i>Saudi Journal of</i>	Attri, JP., Khetarpal R., Chatrath V., and Kaur J. Punjab, India	Gather information regarding the various applications of smartphones in healthcare practices, drawback of the use of these devices and	Literature Review	Smartphones and tablet use has dramatically improved the communication and has become an important learning tool s the medical information can be accesses online at

<i>Anesthesia, 2016, Vol. 10 (1), 87-94</i>		the recommendations regarding the safe use of these devices		anytime. However, these devices have become a significant source of nosocomial infections, distraction for medical professionals and interfere with medical equipments. They may also put privacy and security of patients at stake.
Use of Personal Electronic Device by Nurse Anesthetists and the effects on Patient Safety <i>AANA Journal, 2016, Vol. 84 (2), 114-119</i>	Snoots, L. and Wands, B. United States of America	To illustrate the critical need for further research in order to analyze safety risk, appropriately guide CRNA education, and properly develop and enforce media policies within organizations.	Literature Review	The article described the positive attributes of personal electronic devices, such as being beneficial to communication, but cautioned about ethical and legal implications. Moreover, The article emphasized the gravity of PED's distractive influence.
Bacterial contamination of anesthetists' hands by personal mobile phone and fixed phone use in the operating theatre.	Jeske, H.-C., Tiefenthaler, W., Hohlrieder, M., Hinterberger, G. and Benzer, A. Innsbruck, Austria	To evaluate the role of mobile phones in relation t the transmission of bacteria from the mobile phone to the physician's hands.	Quantitative Research Anesthetists	The use of mobile or fixed phones by anesthetists working in the OR not only demonstrated a high contamination rate with non-human pathogen bacteria, but

<i>Anesthesia, 2007, 62, 904-906</i>				also, more importantly, also caused a 10% rate of contamination with human pathogen bacteria.
2010 Survey on cell phone use while performing cardiopulmonary bypass <i>Perfusion 2011 Vol 26 (5) 375-380</i>	Smith, T., Darling, E. and Searle's, B. United States of America	To determine the frequency of the cell phone use in the perfusion community and to identify concerns and opinions among perfusionists regarding cell phone use.	Qualitative Research Perfusionists	Benefits of cell phone use were identified as being communication and information aids, however, ,majority of perfusionists believe cellphones raise significant safety issues while operating the heart-lung machine. However, majority also have used cell phones while performing this activity

Table 2. Research articles and their results

FIGURES

Figure 2. Initial Thematic Map with 7 themes.